REMARKS

The Examiner is thanked for the careful review of this application. Claims 14-21, are pending after entry of this Amendment. Claims 14-21 have been amended to clarify the claimed invention as described below.

The Office Action Summary recites under "Status" that the Office Action is responsive to communication(s) filed on "7/6/00 (pre-amendment B)." Applicants do not understand the term "pre-amendment B" and request clarification. On 7/6/00, a Divisional Application was filed including the Specification (including the claims and abstract) and Drawings as originally filed in the parent case, and a Preliminary Amendment. The Preliminary Amendment, among other things, amended the claims to those of the present application, and apparently those amended claims (14-21) were examined. The Preliminary Amendment, therefore, is not "amendment B" and Applicant respectfully requests further clarification from the Office.

Objections to the Drawings

The drawings were objected to as failing to comply with 37 CFR 1.84(p)(5) because reference sign 256 cited at page 12, line 14 of the specification was not included in the drawings. Applicants herein submit amended Figure 2A in which --256-- replaces "25 " in the originally submitted Figure 2A. Applicants respectfully request that this objection be withdrawn.

The drawings were objected to as failing to comply with 37 CFR 1.84(p)(5) because Figure 1D includes reference number "130" not mentioned in the description. The paragraph in the originally submitted specification at page 3, line 14, is herein amended to include clarification of Figure 1D as --in a plot 130 of plasma concentration versus surface locations as shown in Figure 1D--. Figure 1D is labeled as such a plot, and therefore no new matter is introduced. Applicants respectfully request this objection be withdrawn.

The drawings were objected to as failing to comply with 37 CFR 1.84(p)(4) because the reference character "140" was used to designate two different features in Figure 1E. Amended Figure 1E is herein submitted with one of the "140" references amended to --141--. The paragraph in the originally submitted specification beginning on page 3, line 22, and concluding on page 4, line 8, is herein amended to change "a cross sectional view 140" to --a cross sectional view 141--. Applicants respectfully request this objection be withdrawn.

Objections to the Specification

The Abstract of the Disclosure was objected to because it contains more than 150 words. Applicants herein submit an amended Abstract of the Disclosure, and respectfully request the objection be withdrawn.

Rejections under 35 U.S.C. §112

Claims 14-21 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention. The preamble of claim 14 was deemed confusing, and Applicants herein amend claim 14 to more specifically recite a method for making a top electrode for use in a chamber. Claims 15-21 are amended in accordance with the preamble to amended claim 14. Applicants respectfully request that this rejection be withdrawn.

Claim 14 was further deemed to recite the term "the system" without proper antecedent basis. Applicants have amended the claim to recite --the chamber--, and request this objection be withdrawn.

Claims 15, 18, and 20-21 were asserted to be unclear as claiming limitations that are not directed to a method for making an electrode according to the preamble. Applicants respectfully traverse this rejection, and request reconsideration. In claim 15,

the limitation of "coupling the top electrode to one of the pair of RF power sources and the support chuck to the other one of the pair of RF power sources" suggests not only use, but that the electrode must be "made" such that the electrode can be coupled to one of the pair of RF power sources while the support chuck is coupled to the other one of the pair of RF power sources. Similarly, in claim 18, the electrode is made for use in a chamber in such a manner as to capable of "fixing a separation of between about 0.75 cm and about 4 cm between the electrode surface and the wafer surface." Finally, claims 21 and 20 recite limitations that further define the method of making the electrode in order to strike a plasma having a first plasma sheath surface area that is proximate to the wafer surface and a second plasma sheath surface area that outlines an inner region of the top electrode openings. The electrode is "made" in such a way as to achieve a plasma sheath that is defined by the surface area of the electrode having a larger surface area defining the second plasma sheath surface area adjacent to the surface of the electrode than the surface area of the wafer having a first plasma sheath surface area adjacent to the surface of the wafer. In achieving a larger surface area of the plasma sheath adjacent to the electrode than the surface area of the plasma sheath adjacent to the wafer surface, the electrode can induce increased ion bombardment energy over the wafer surface.

Applicants further note that minor clarifying amendments are submitted to claims 20 and 21 to more clearly recite --surface area-- with respect to the plasma sheath. Examiner is directed to Applicants' specification pages 14-17 for support of the submitted amendments. No new matter is introduced. Accordingly, Applicants respectfully request the §112 rejections to claims 15, 18, and 20-21 be withdrawn.

The last §112 rejection asserts that the term "at least about" as used in claim 16 is a relative term which renders the claim indefinite. Applicants traverse this rejection, and request reconsideration. As described in Applicants' specification at page 13, lines 2-4, "The electrode opening 202b has a diameter D_3 242 that is selected to be at least equal to

or greater than about $5\Lambda_{Debye}$ (*i.e.*, $\geq$ 0.5mm)." The recited limitation "at least" recites a minimum limitation in accordance with "greater than or equal to," and "about" reflects an acceptable approximation of the unit of measurement, and in particular in conversion between units of measurement. One of ordinary skill in the art is reasonably apprised of the scope of the invention, provided in the specification with a reasonable standard for ascertaining the requisite degree. Applicants respectfully request this rejection be withdrawn.

Rejections under 35 U.S.C. §103

Claims 14-21 were rejected under 35 U.S.C. §103(a) as being unpatentable over Degner et al. (U.S. Patent No. 5,074,456) in view of Chang et al. (U.S. Patent No 4,854,263). This rejection is respectfully traversed.

Applicants' independent claim 14, as amended herein, claims a method for making a top electrode for use in a chamber for processing a semiconductor wafer through plasma etching operations. The chamber includes a support chuck for holding the wafer, and a pair of RF power sources. The method includes forming the top electrode to have a center region, a first surface and a second surface. The first surface has an inlet that is configured to receive processing gases from a source that is external to the chamber, and to flow the processing gases into the center region. The second surface has a plurality of gas feed holes that lead to a plurality of electrode openings. The diameters of the electrode openings are greater than diameters of the gas feed holes. The plurality of electrode openings are configured to define the second surface which is located over a wafer surface of the semiconductor wafer.

Degner et al. show a composite electrode useful particularly in parallel plate plasma reactor apparatus. Degner et al. teach a pair of baffle plates located between a backing plate and an electrode plate, as well as a plurality of orifices in the electrode plate through which reactant gases are distributed. However, Degner et al. does not show or

suggest the Applicants' claimed electrode. According to Degner et al., "The [electrode] plate will generally be flat and free from protuberances..." Although Degner et al. do not describe in detail the reactant gas orifices, the design and purpose of the orifices is essentially for introduction of reactant gases while minimizing "non-uniformities in the thermal, electrical, and structural properties of the disk." Degner et al. shows a flat-surfaced, composite electrode.

Chang et al. describe a gas manifold that can act as an electrode used in a plasma-enhanced chemical vapor deposition system (PECVD). Essentially, Chang et al. teach chemical vapor deposition onto a substrate, and the stated objects are providing a gas manifold designed to increase the dissociation and reactivity of gases such as nitrogen, providing an improved parallel plate and gas inlet manifold configuration for forming low hydrogen content silicon nitride films at high deposition rates using nitrogen with reduced ammonia or without ammonia. Chang et al. also state that an objective of the invention is to provide an improved parallel plate electrode and gas inlet manifold configuration for forming silicon oxide films and for forming low hydrogen content silicon oxynitride films at high deposition rate using nitrogen with reduced ammonia or without ammonia.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references when combined must teach or suggest all the claim limitations. (MPEP §2143). Applicants respectfully submit the Office has failed to establish a *prima facie* case of obviousness.

Regarding the suggestion or motivation to combine references in a manner as suggested by the Examiner, Applicants' submit that no suggestion or motivation exists. While there may be some similarities between plasma etch and CVD, the essential

technologies remain distinct. Plasma etch is directed at removing material from a substrate, and CVD is directed at depositing material onto a substrate. The Degner et al. electrode is designed to enhance uniform electrical and thermal characteristics, with an exposed face free from protuberances. The Chang et al. electrode, on the other hand, incorporates a large number of closely packed apertures having an increasing diameter. The increasing diameter in the direction of gas flow increases the dissociation and associated reactivity of gases such as nitrogen and, thus, increases deposition rates. There is simply no motivation to combine a feature that increases deposition rates into a structure for etching.

Further, even if the proposed combination were accomplished, the result would not be the claimed invention, and would most probably render the modified Degner et al. electrode unsatisfactory for its intended purpose. Degner et al. strive to achieve uniform electrical and thermal characteristics, through use of an essentially flat, simple disk. Any combination of Degner et al. and Chang et al. will certainly destroy the electrical uniformity, and perhaps the thermal uniformity as well. More significantly, the Degner et al. reference teaches a flat surface free of protuberances. The shower head disclosed by Chang et al. would essentially add numerous, closely packed protuberances to the surface of the Degner et al. electrode.

Applicants' claimed invention is directed toward an etch process system. The "plurality of electrode openings that have electrode opening diameters that are greater than gas feed hole diameters of the plurality of gas feed holes" of Applicants' claimed invention are designed and configured to increase the surface area of the electrode plate such that the surface area of the plasma sheath flowing over that surface will be greater than the surface area of the plasma sheath flowing over the surface of the wafer, resulting in an increase in the bias voltage on the wafer side and resulting increase in ion bombardment directed at the wafer, and without changing other process parameters that

would result in increasing plasma density. In so doing, Applicants' present invention achieves higher aspect ratio geometries without causing premature etch stops or bow etch profiles.

The patents to Degner et al. and to Chang et al., either alone or in combination, simply do not teach or suggest the features of the Applicants' claimed invention as recited in Applicants' claims 14-21 as herein amended.. The Office has therefore failed to establish a *prima facie* case of obviousness with respect to Applicants' claims 14-21, and Applicants therefore respectfully request the §103 rejections be withdrawn.

In view of the foregoing, Applicants respectfully request reconsideration of claims 14-21, and submit that these claims are in condition for allowance. Accordingly, a Notice of Allowance is respectfully requested. If Examiner has any questions concerning the present amendment, the Examiner is kindly requested to contact the undersigned at (408) 749-6900, ext. 6905. If any additional fees are due in connection with filing this amendment, the Commissioner is also authorized to charge Deposit Account No. 50-0805 (Order No. LAM1P077A).

Respectfully submitted,
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MARKED UP SPECIFICATION

The two paragraphs beginning at Page 3, Line 14, and running through Page 4, line 8 in the originally filed specification are amended as indicated:

Specifically, in a plot 130 of plasma concentration versus surface locations as shown in Figure 1D, plasma sheaths edges are defined at points 133a and 133b along a plasma density profile 133. The plasma density profile 133 illustrates that the plasma concentration falls to about zero near the wafer surface 136 and at the top electrode surface 134. As such, the plasma concentration gradually increases from zero up to a constant concentration between points 133a and 133b. The electrode surface 134 and the wafer surface 136 will therefore ensure that the bulk of the plasma is contained between the plasma sheaths 131 and 132 as shown in Figure 1C.

As the demand to etch smaller and smaller integrated circuit device patterns continues to increase, more difficult high aspect ratio etching will be needed. As shown in Figure 1E, a cross sectional view [140] 141 of a wafer substrate 106' is shown. The wafer substrate 106' has a dielectric layer 140 deposited thereon and a patterned photoresist layer 142. The photoresist layer 142 has a patterned window 144 defining a window down to the dielectric layer 140. As aspect ratios continue to increase (*i.e.*, deeper and narrower etching geometries), a process window that defines a set of controllable process parameters will also rapidly shrink. When the process window shrinks, adjustment of process parameters will no longer improve etch rates, etch selectivities, or etch profiles.

MARKED UP CLAIMS:

The claims are herein amended as indicated.

14. (Twice Amended) A method for making a top electrode for use [In] in a chamber for processing a semiconductor wafer through plasma etching operations, the chamber including a support chuck for holding the semiconductor wafer and a pair of RF power sources; [a method for making a top electrode for the chamber,] the method comprising:

forming the top electrode to have a center region, a first surface and a second surface, the first surface has an inlet that is configured to receive processing gases from a source that is external to the [system] chamber and flow the processing gases into the center region, the second surface has a plurality of gas feed holes that lead to a plurality of electrode openings that have electrode opening diameters that are greater than gas feed hole diameters of the plurality of gas feed holes, the plurality of electrode openings are configured to define the second surface which is located over a wafer surface of the semiconductor wafer.

15. (Amended) The method for making a top electrode for use in the chamber as recited in claim 14, further comprising:

coupling the top electrode to one of the pair of RF power sources and the support chuck to the other one of the pair of RF power sources.

16. (Twice Amended) The method for making a top electrode for use in the chamber as recited in claim 15, further comprising:

forming the electrode openings to be at least about 0.5 mm or greater in diameter and the gas feed holes to have a diameter of about 0.1 mm.

17. (Amended) The method for making a top electrode for use in the chamber as recited in claim 15, further comprising:

defining the electrode openings to a depth of between about 1/32 inch and ¼ inch.

18. (Amended) The method for making a top electrode for use in the chamber as recited in claim 16, further comprising:

fixing a separation of between about 0.75 cm and about 4 cm between the electrode surface and the wafer surface.

19. (Amended) The method for making a top electrode for use in the chamber as recited in claim 18, further comprising:

inserting two or more gas buffer plates within the center region of the top electrode.

20. (Amended) The method for making a top electrode for use in the chamber as recited in claim 18, further comprising:

striking a plasma between the separation, the plasma having a first plasma sheath surface area that is proximate to the wafer surface and a second plasma sheath surface area that outlines an inner region of the top electrode openings, such that the second plasma sheath surface area [has an area that] is greater than the first plasma sheath surface area.

21. (Amended) The method for making a top electrode for use in the chamber as recited in claim 20, further comprising:

increasing an ion bombardment energy over the wafer surface when the second plasma sheath surface area [has the area that] is greater than the first plasma sheath surface area.